PATENT

Case No. N0084US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
M. SALAHUDDIN KHAN
MATTHEW FRIEDERICH

Serial No. 09/784,660

Title: DYNAMIC BUILDING, MAINTENANCE AND USE OF SPATIAL WORD LIST FOR AUTOMATIC SPEECH GENERATION (as amended)

Filed: February 15, 2001

DECLARATION UNDER 37 CFR 1.131

The undersigned, M. SALAHUDDIN KHAN and MATTHEW FRIEDERICH, each hereby declare that:

1. We are co-inventors of the invention described and claimed in the above-identified patent application.

2. Before March 14, 2000, we invented a new method and system for automatic speech recognition (ASR) for use with mobile systems, such as navigation systems. Our new method included the steps of forming a word list to be used by an ASR algorithm by adding names for geographic features located in proximity to a user's current position to names for geographic features selected without regard to proximity to the user's current position, and then rebuilding the word list when the user's current position is changed, e.g., by a given distance threshold, to reflect the user's changed current position. Our invention also included a system, including hardware, software and data, for implementing these steps.

3. Before March 14, 2000, we prepared an Invention Disclosure Statement Form describing our invention. We filed the Invention Disclosure Statement Form with the Legal Department of the assignee of the subject patent application. A redacted copy of the Invention Disclosure Statement is attached hereto.

4. The section entitled "Detailed Description of Invention" in the attached Invention Disclosure Information Form discloses the elements of our invention recited in paragraph 2., above.

5. All statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

M.S. Khan
M. SALAHUDDIN KHAN

September 25th, 2009
DATE

MATTHEW FRIEDERICH

September 30th, 2009
DATE

INVENTION DISCLOSURE STATEMENT

(Return to Legal Department)

IDS # [redacted]
(to be filled out by Legal Dept.)

Shorthand Name for Invention: Decreasing Density Radial Name Searches

Developers Who Contributed to Invention:

1. Salahuddin Khan
2. Matthew Friederich
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....

Date (or Month) on Which Development Began:	[redacted]
If Known, First Date (if any) on Which Development was:	
(a) described in a CONFIDENTIAL document released outside of NavTech.	
(b) described in a CONFIDENTIAL conversation with a non-NavTech employee	
(c) described in a NON-confidential document released outside of NavTech	
(d) described in a NON-confidential conversation with a non-NavTech employee	
(e) included in any version of a product released outside of NavTech	
(f) used internally at NavTech in the normal course of operations:	

Summary of Invention:

An approach to dynamically identifying names that a driver *might* utter so as to improve an ASR algorithm's performance (by reducing its search-space) without significantly decreasing performance.

Advantages of Invention (to the extent known):

Improve performance (as measured by reduced processing time and reduced memory requirements) of ASR algorithms operating in an in-vehicle environment.

Detailed Description of Invention

- **describe function(s) performed**
- **describe with particularity the way in which each function is achieved (e.g., if the invention is a process, describe each step of the process):**

Definition: ASR == Automatic Speech Recognition

ASR algorithms operate by finding a best match between an utterance and a known list of keywords (or candidates). At a basic level, these algorithms analyze an utterance and compare it to each keyword in the list. Each keyword is assigned a "likelihood". The keyword with the highest likelihood is returned as the match, if the likelihood exceeds some threshold. If no keyword likelihood exceed the threshold, no match is found.

The analysis and comparison functions require significant system resources. In embedded systems with limited memory, the maximum size of a keyword list is about 1500 names, and perhaps much smaller. However, a typical navigation database will have thousands and thousands of names – POI names, place names, and street names.

Given this scenario, the problem becomes one of limiting the number of names that are candidates. One approach is to introduce "category" keywords. For example, one could create a keyword list such as ["POI" "Place" "Street name"]. Then, the driver is required to first say "Place" before saying "Michigan". The first keyword, "Place", limits the next search to places (as opposed to street names or POIs).

While this approach will work in some cases, it will not work for other cases. For example, saying "Street name" to constrain a search within Germany will still yield a candidate list too large for a small system to process. The same is true for POIs.

Another solution requires the driver to provide more keyword information. For example, "Street name" "Oak Park" will

narrow the search to streets in Oak Park. However, this approach also has significant drawbacks. For example, a driver wanting to go to "931 Lake Street" may not know whether the destination is in Oak Park, Chicago, or some other community. In fact, an out-of-town driver cannot be expected to know the names of suburban communities.

This brings us to the concept of a decreasing density radial name search. The basic idea is that the list of candidate names will be populated based on a name's proximity and importance. Thus, "nearby" names will generally be included in the candidate list. Names far away, e.g. in New York for a Chicago-located driver, will generally not be in the list. But a handful of important New York names, such as Manhattan, will be.

As the driver travels from Chicago to New York, the candidate list will periodically be rebuilt to reflect the driver's changed position. As the driver approaches Manhattan, the candidate list will include nearly all Manhattan names but very few Chicago names.

In order to support decreasing density radial name searches, we must provide the following data:

- A spatial name index which can be used to order names by proximity to a location, names falling along a vector, or names between two points.
- Name importance information. This data says that the name "Chicago" is more important than "Rosemont", which is more important than "Cicero". It should be available to limit searches for candidate list names.

When this information is available, an application can build a run-time candidate name list of optimal size given ASR algorithm constraints and hardware limitations.

Please check the appropriate box:

☒ **No design documents exist**

☐ **The following design documents exist (and copies are attached):**

Signature: _____ Date: [redacted]
(of preparer-developer)

Type Name: Matthew Friederich

Signature(s) of Contributing Developers:

1. Name: M.S. _____ Date: [redacted]
2. Name: _____ Date: _____
3. Name: _____ Date: _____